

Problem Set 2: Scattering amplitudes in gauge theories

Discussion on Wednesday 11.03 12:45-14:30, HIT H 51
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Exercise 3 – Fierz rearrangement

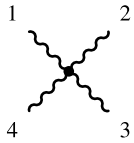
Prove the Fierz rearrangement formula

$$[i|\gamma^\mu|j\rangle \langle l|\gamma_\mu|k] = 2[ik] \langle lj\rangle.$$

quoted in class.

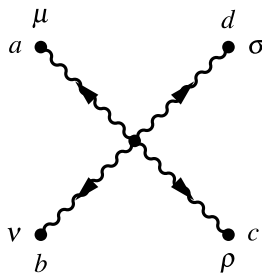
Exercise 4 – Color ordered four-point vertex

Derive the color ordered four-point vertex



$$g^2 \frac{i}{2} \left[2(\epsilon_1 \cdot \epsilon_3) (\epsilon_2 \cdot \epsilon_4) - (\epsilon_1 \cdot \epsilon_2) (\epsilon_3 \cdot \epsilon_4) - (\epsilon_1 \cdot \epsilon_4) (\epsilon_2 \cdot \epsilon_3) \right]$$

with ‘dummy’ polarization vectors ϵ_i^μ from the Feynman rules for the 4-point vertex



$$iV_{\mu\nu\rho\sigma}^{abcd} = -ig^2 [f^{abe} f^{cde} (\eta_{\mu\rho} \eta_{\nu\sigma} - \eta_{\mu\sigma} \eta_{\nu\rho}) \\ + f^{ace} f^{dbe} (\eta_{\mu\sigma} \eta_{\rho\nu} - \eta_{\mu\nu} \eta_{\rho\sigma}) \\ + f^{ade} f^{bce} (\eta_{\mu\nu} \eta_{\sigma\rho} - \eta_{\mu\rho} \eta_{\sigma\nu})]$$

stated in class.

Exercise 5 – Independent 4 and 5 gluon partial amplitudes

Use the relations discussed in class and in chapter 1.10 of the book amongst the color-ordered amplitudes to determine the independent set of color-ordered amplitudes for 4 and 5 gluon scattering.